WBJEE(Engineering) : 2023

(Solutions)

Test Booklet Code ✿

Date : 30.04.2023

CHEMISTRY

Category – I (Q.41 to 70)

(Carry 1 mark each. Only one option is correct. Negative marks : – ¼)

41. Solution : **(D) $[CoF_6]^{3-}$ is paramagnetic with 2 unpaired electrons.**

$V^{3+} \rightarrow 3d^2$ (paramagnetic, 2 unpaired electron)

$Cu^{2+} \rightarrow 3d^9$ (paramagnetic, 1 unpaired electron)

$Co^{3+} \rightarrow 3d^6$ (strong field $t_{2g}^6 e_g^0$, diamagnetic)

$Co^{3+} \rightarrow 3d^6$ (weak field, paramagnetic, 5 unpaired electrons)

42. Solution : **(A) 5.9 BM, 1.732 BM**

$[\overset{+3}{Fe}Cl_4]^{\ominus} \Rightarrow 3d^5$ (weak field, so 5 unpaired electrons)

$\mu = \sqrt{5 \times 7} = 5.9$ BM

$[\overset{III}{Fe}(CN)_6]^{3-} \Rightarrow 3d^5$ (strong field, $t_{2g}^5 e_g^0$, so one unpaired electron)

$\mu = \sqrt{1 \times 3} = 1.732$ BM

43. Solution : **(B) $2BrF_3 \rightleftharpoons BrF_2^+ + BrF_4^-$**

Self ionisation

$2BrF_3 \rightleftharpoons BrF_4^- + BrF_2^+$

44. Solution : **(B) Pr^{3+}**

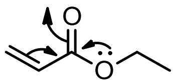
$Pr(4f^3 6s^2) \rightarrow Pr^{3+}(4f^2)$

$Nd(4f^4 6s^2) \rightarrow Nd^{3+}(4f^3)$

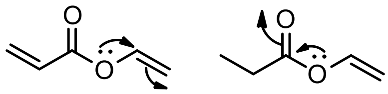
$Pm(4f^5 6s^2) \rightarrow Pm^{3+}(4f^4)$

45. Solution : (D) II > I > III

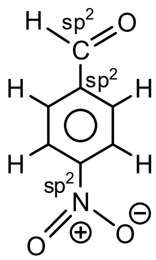
Bond length $\propto \frac{1}{\text{bond order}}$

(II) is maximum due 

(III) is minimum since lone pair of ester oxygen can play on both $>C=O$ as well as C=C side

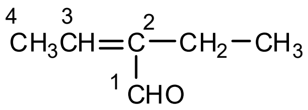


46. Solution : (A) 4-Nitrobenzaldehyde



All atoms are in the same plane, sp^2 hybridised.

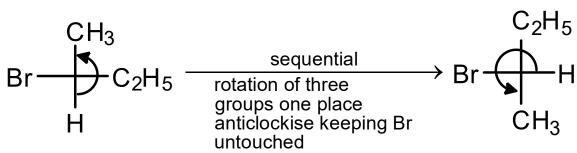
47. Solution : (B) 2-Ethylbut-2-enal



2-Ethylbut-2-enal

48. Solution : (C) enantiomer, homomer (identical), diastereomer

In 1, one pair of groups are interchanged hence enantiomer

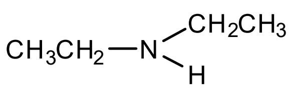
2,  hence homomer

3. trans and Cis are known as diastereomers

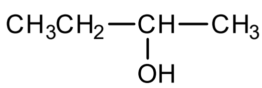
49. Solution : (C) III > IV > I > II

Out of all allylic carbocation α –NMe_2 group has highest electron donating compare to $-\ddot{O}Me$, then C–Me and least for –BMe_2 since Boron is electron deficient

50. Solution : (C) II < I < III



mol. mass 73



mol. mass 74

$CH_3CH_2-O-CH_2CH_3$

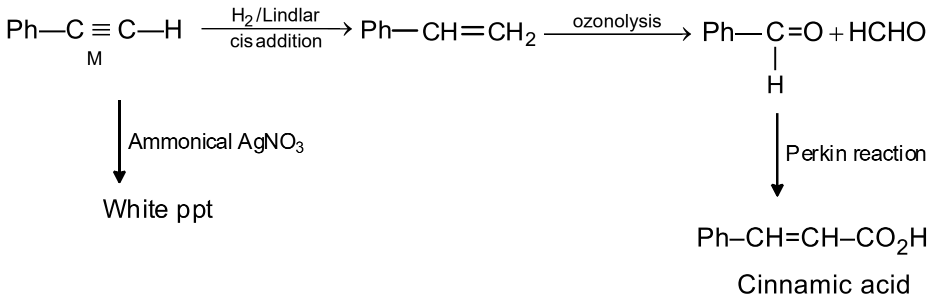
mol. mass 74

Molar mas remaing same –OH will have higher b.p. then NH and least for ether due to strength of H-bonding

51. Solution : (A) Ph–C≡CH

$$\underline{O} \xrightarrow[CH_3COONa]{(CH_3CO)_2O} \underset{\text{cinnamic acid}}{C_6H_5CH = CHCO_2H}$$

hence $\underline{O}$ is benzaldenyde, N is an alkene with a phenyl group, M is substituted alkyne i.e. Ph–C≡CH whole sequence is shown.

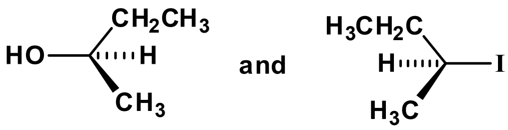


52. Solution : (D) IV > III > I > II

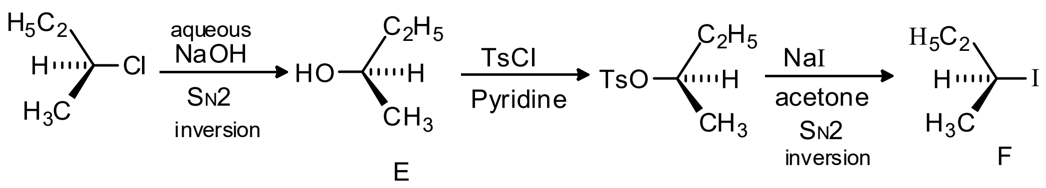
$$\text{Acidity of Phenol} \propto \text{strength of EWG} \propto \frac{1}{\text{strength of EDG}}$$

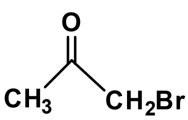
EWG order $\rightarrow NO_2 > –CH=CH_2$

EDG order $\rightarrow –NMe_2 > –CH_3$

53. Solution : (D) 

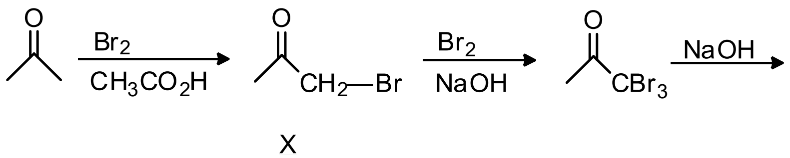
In tosylation reaction C-oxygen bond does not break, aqueous NaOH and NaI/acetone leads to SN2 and uinversion in configuration as shown below



54. Solution : (A) X = 

Y = $CHBr_3$ Z = CH_3CO_2Na

Acid catalysed enolisation stops after monobromination while due to base catalysed enolisation 2nd step is faster and so all α-H atoms are halogenated and finally tribomo compound in presence of base will form bromoform and acetate ion.



$$\underset{\underline{Y}}{CHBr_3} + \underset{\underline{Z}}{CH_3CO_2Na}$$

55. Solution : (A) IV < III < II < I

i) 1 mole $N_2 \rightarrow 28$ g

ii) 0.5 mole $O_3 \rightarrow 24$ g

iii) 0.5 mole $O_2 \rightarrow 16$ g

iv) 0.5 gm atom $O_2 \rightarrow 8$ g

So, IV < III < II < I

56. Solution : (B) 3 : 4

$m_1 = 100$ g $\quad\quad m_2 = 50$ g

v $\quad\quad$ 1.5 v

$$\lambda = \frac{h}{p}$$

$$\therefore \lambda_1 : \lambda_2 = \frac{h}{p_1} : \frac{h}{p_2} = \frac{p_2}{p_1} = \frac{50 \times 1.5\,v}{100 \times v} = \frac{3}{4}$$

57. Solution : (D) 173.2 pm

Body diagonal $= \sqrt{3}a$

$$\therefore \sqrt{3}a = 4r$$

$$\therefore a = \frac{4 \times 75}{\sqrt{3}} = 100\sqrt{3}\ \text{pm} = 173.2\ \text{pm}$$

58. Solution : (C) 2x

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$\therefore \frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} \times \sqrt{\frac{M_1}{M_2}} = \sqrt{2} \times \sqrt{2} = 2$$

$$\therefore \frac{v_2}{x} = 2 \Rightarrow v_2 = 2x$$

59. Solution : (D) In k vs 1/T

$$k = Ae^{-Ea/RT}$$

$$\Rightarrow \ln K = \ln A - \frac{E_a}{RT}$$

$\therefore$ lnk vs $\dfrac{1}{T}$ is a straight line.

60. Solution : (B) 390.71 $ohm^{-1}\ cm^2\ eq^{-1}$

$$\Lambda_e^0(CH_3COOH) = \lambda^0_{CH_3CO^-} + \lambda^0_{H^+}$$

$$= \Lambda_e^0(HCl) + \Lambda_e^0(CH_3COONa) - \Lambda_e^0(NaCl)$$

= (426.16 + 91) – 126.45 = 390.71 $ohm^{-1}\ cm^2\ eq^{-1}$

61. Solution : (C) First order with respect to A and second order with respect to B

1) When conc. of A increases 10 times rate increases 10 times. So rate w.r. to A is 1st order.

2) When [B] increases 10 times rate increases 100 times. So rate w.r. to B is 2nd order.

62. Solution : (B) $(0.693)^{1/2}$

$$T_{1/2} = \frac{0.693}{\lambda}$$

$$\therefore T_{1/2} = \lambda = (0.693)^{1/2}$$

63. Solution : (B) $Ar^+ + Kr^+$

Size of Kr > size of Ar

$\therefore$ less energy is required to ionize Kr

So frequency required for Ar will be able to ionize Kr not smaller size atoms.

64. Solution : (B) 82000

$$\pi = CRT$$

$$3 \times 10^{-4} = \frac{4}{M \times 4} \times R \times 300$$

$$\therefore M = \frac{0.082 \times 300}{3 \times 10^{-4}} = \frac{8.2 \times 3}{3 \times 10^{-4}} = 8.2 \times 10^4$$

65. Solution : (C) M/6

$$K\overset{+5}{I}O_3 \xrightarrow{+6e} K\overset{-1}{I}$$

$n_f = 6$

$$\therefore E(KIO_3) = \frac{M}{6}$$

66. Solution : (D) 21301 cal/mol

$$\Delta G^0 = -RT\ln K_{eq}$$

$$= -1.98 \times 298 \ln(1.8 \times 10^{-16}) \left[\because K_{eq} = \frac{10^{-14}}{55.55}\right]$$

$$= -1.98 \times 298(\ln 1.8 - 16 \times 2.3)$$

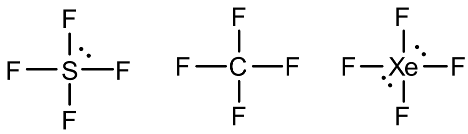
$$= -1.98 \times 298(0.587 - 36.8) = 21367.11$$ cal/mole (Nearest to option D)

[**Note:** In the problem STP condition is mentioned, at the same time pH of water is 7 but pH water is 7 at only 298 K. To define standard free energy change pressure is more important to mention than temperature.]

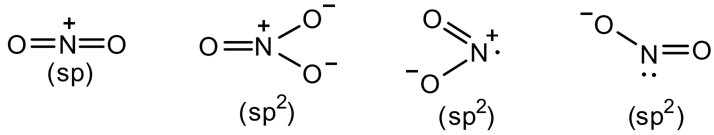
67. Solution : (C) $KHCO_3$ is appreciably soluble

$KHCO_3$ is appreciably soluble so it can not be separated by filtration.

68. Solution : (D) different with 1, 0 and 2 lone pairs of electrons on the central atoms, respectively



69. Solution : (C) NO_2^+



70. Solution : (A) Both are paramagnetic

$\overset{III}{[Fe(CN)_6]^{3-}} \Rightarrow Fe^{3+}(3d^5)$

strong field

$t_{2g}^5 e_g^0 \Rightarrow$ paramagnetic 1 unpaired electron

$[FeF_6]^3 \Rightarrow Fe^{3+}(3d^5)$

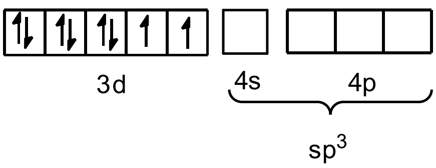
weak field

$t_{2g}^3 e_g^2 \Rightarrow$ paramagnetic 5 unpaired electron

Category – II (Q.71 to 75)

(Carry 2 marks each. Only one option is correct. Negative marks : – ½)

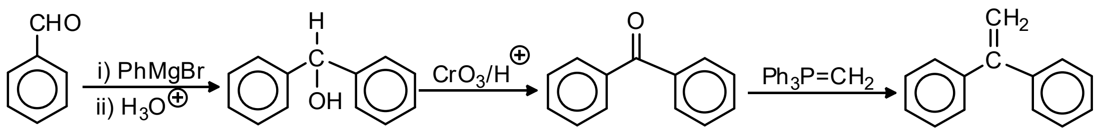
71. Solution : (A) sp^3, two

$[NiX_4]^{2-} \Rightarrow Ni^{+2}(3d^8) \Rightarrow$ 

$\therefore$ unpaired electrons = 2

72. Solution : (A) Benzaldehyde

The compound N is benzophenone which on Wittig reaction produces alkene $[Ph_2C=CH_2]$. Hence M must be Ph—CH(—Ph)—OH obtained by phenyl Grignard with L.



73. Solution : (C) $CH_3CH_2COOCH_2CH_2CH_3$

$$\underset{\text{G(an ester)}}{C_6H_{12}O_2} \xrightarrow[\text{(ii) } H_3O^{\oplus}]{\text{(i) alkaline hydrolysis}} \underset{\text{an alcohol}}{H} + \underset{\text{an acid}}{I}$$

$$H \xrightarrow{CrO_3/H^{\oplus}} I$$

As the alcohol H on oxidation gives I the acid obtained from hydrolysis hence alcohol must be primary having same number of carbon atoms with the acid, hence the answer...

74. Solution : (B) Both the averages are halved

$$\overline{K.E} = \frac{3}{2}RT$$

$$V_{av} = \sqrt{\frac{8RT}{\pi M}}$$

for Case-2

$$\overline{KE} = \frac{3}{2}R\frac{T}{2}$$

$$V_{av} = \sqrt{\frac{8RT}{\pi.2.2M}} = \frac{1}{2}\sqrt{\frac{8RT}{\pi M}}$$

75. Solution : (B) 1.0 M

$$\text{Molarity} = \frac{\frac{63}{126}\times 1000}{\frac{563}{1.126}} = \frac{63\times 1.126\times 1000}{126\times 563} = 1$$

Category – III (Q.76 to 80)

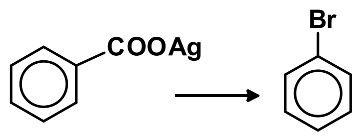
(Carry 2 marks each. One or more options are correct. No negative marks)

76. Solution : (A,D) (A) - (5, 2, 1), (D) - (5, 2, –1)

$5d \Rightarrow n = 5, l = 2$

$\therefore$ (5, 2, 1) and (5, 2, –1) are correct

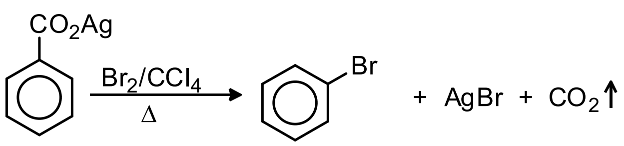
77. Solution : (A,D) (A) - $PhCH{=}CHCH_3 \rightarrow PhCHBrCHBrCH_3$, (D) -



Br_2/CCl_4 can be used in electrophilic addition in alkene as well as Huns-Diecker reaction.

(A) $PhCH{=}CH{-}CH_3 \xrightarrow[\text{anti addition}]{Br_2/CCl_4} Ph{-}\underset{\underset{Br}{|}}{C}H{-}\underset{\underset{Br}{|}}{C}H{-}CH_3$

(D)



78. Solution : (A,C,D) **(A) - (i) Br_2/Fe (ii) Mg/dry ether (iii) CO_2 (iv) $H_3O^{\oplus}$**

(C) - (i) CH_3Cl, Anhydrous $AlCl_3$ (ii) $KMnO_4$ | $\overset{\ominus}{O}H$, Δ (iii) $H_3\overset{\oplus}{O}$

(D) - (i) CH_3COCl, Anhydrous $AlCl_3$ (ii) Br_2, NaOH (iii) $H_3O^{\oplus}$

$$C_6H_5 \xrightarrow[\text{electrophilic substitution}]{\text{i)}Br_2/Fe} PhBr \xrightarrow[\text{dry ether}]{\text{i)Mg in}} PhMgBr \xrightarrow[H_3O^{\oplus}]{\text{iii) }CO_2} PhCO_2H$$

$$C_6H_5 \xrightarrow[\text{anhydrous } AlCl_3]{\text{i) }CH_3Cl} PhCH_3 \xrightarrow[OH^{\ominus}]{\text{ii) }KMnO_4} PhCOO^{\ominus} \xrightarrow{H_3O^{\oplus}} PhCO_2H$$

$$C_6H_5 \xrightarrow[\text{anhydrous } AlCl_3]{\text{i) }CH_3COCl} PhCOCH_3 \xrightarrow[NaOH]{\text{ii) }Br_2} \underset{+\,CHBr_3}{PhCOONa} \xrightarrow{H_3O^{\oplus}} PhCO_2H$$

79. Solution : (A,D) **(A) - A gas cannot be liquified**

(D) - Density changes continuously with P or V

Above critical temperature

A) A gas cannot be liquified.

B) No existence of liquid.

C) This is applicable at critical temperature only.

D) With increasing P, V decreases and hence density increases.

80. Solution : (B,C) **(B) - NH_4OH + HCl (2 : 1 mole ratio), (C) - CH_3COOH + NaOH (2 : 1 mole ratio)**

A) Only salt (CH_3COONa) will be formed

B) $NH_4OH + NH_4Cl$

C) $CH_3COOH + CH_3COONa$

D) CH_3COONa + NaOH